RANCH DAY

OCTOBER 11, 1948

New Mexico Experiment Station, New Mexico Extension Service

Southwestern Forest and Range Experiment Station

UNGRAZED IN SUMMER

GRAZED YEARLONG

More than twice as much herbage is produced per acre by black grama grazed only during the non-growing season.

Experimental Ranch

New Mexico College of A. and M. A.

Jornada Experimental Range

Southwestern Forest and Range Experiment Station

PROGRAM

EIGHTH ANNUAL RANCH DAY

J. H. Knox, Animal Husbandry Dept., New Mexico College of Agriculture & Mechanic Arts, presiding.

8:00 AM Leave Dona Ana Courthouse, Las Cruces, New Mexico.

8:40 Seasonal Grazing. Comparison Jornada Pastures 6 and 10. Range Research of the Southwestern Forest & Range Experiment Station. C. Kenneth Pearse, Chief, Division of Range Research, Southwestern Forest & Range Experiment Station.

Seasonal use of southwestern ranges and current range conditions. Fred N. Ares, Superintendent, Jornada Experimental Range.

10:00 Mesquite in beginning stages of invasion. Value of early control of Mesquite. S. Clark Martin, Southwestern Forest & Range Experiment Station.

10:45 Mesquite control. Chemical control of Mesquite. S. Clark Martin, Southwestern Forest & Range Experiment Station.

Shrub control studies under the Research & Marketing Act. G. E. Glendening, Southwestern Forest & Range Experiment Station.

11:15 Demonstration of Airplane Spraying of Mesquite. Marsh Aviation Co., and Dow Chemical Co.

12:00 Chuck-wagon lunch. Headquarters, Jornada Experimental Range.
Welcome -- Raymond Price, Director, Southwestern Forest & Range Experiment Station, J. R. Nichols, President, New Mexico College of Agriculture & Mechanic Arts.

Range Management problems and the ranchman. G. W. Evans, President, New Mexico Cattle Growers Association.

Management of the Jornada Experimental Range herd. B. A. Christmas, Cooperator, Jornada Experimental Range.

2:30 PM West Well reseeding enclosure. Reseeding research - a broad program. Hudson G. Reynolds, Southwestern Forest & Range Experiment Station.

Reseeding New Mexico ranges. H. W. Springfield, Southwestern Forest & Range Experiment Station

3:15 Camp Well, College Ranch. The influence of bulls on the weight and grade of calves. Marvin Koger, New Mexico College of Agriculture & Mechanic Arts.

4:00 Rodent plot. Effects of rodents and rabbits on rangeland. J. J. Norris, New Mexico College of Agriculture & Mechanic Arts.

JORNADA EXPERIMENTAL RANGE

JORNADA H.Q

Reseeding area

Rincon

West Well

Rodent Plots

Mayfield Well

Camp Well

Co'op Well

Seasonal Grazing

Mesquite Control

Seldon Well

Rodent Study

COLLEGE H.Q.

South Well

COLLEGE RANCH

Summerford Mt.

Radium Springs

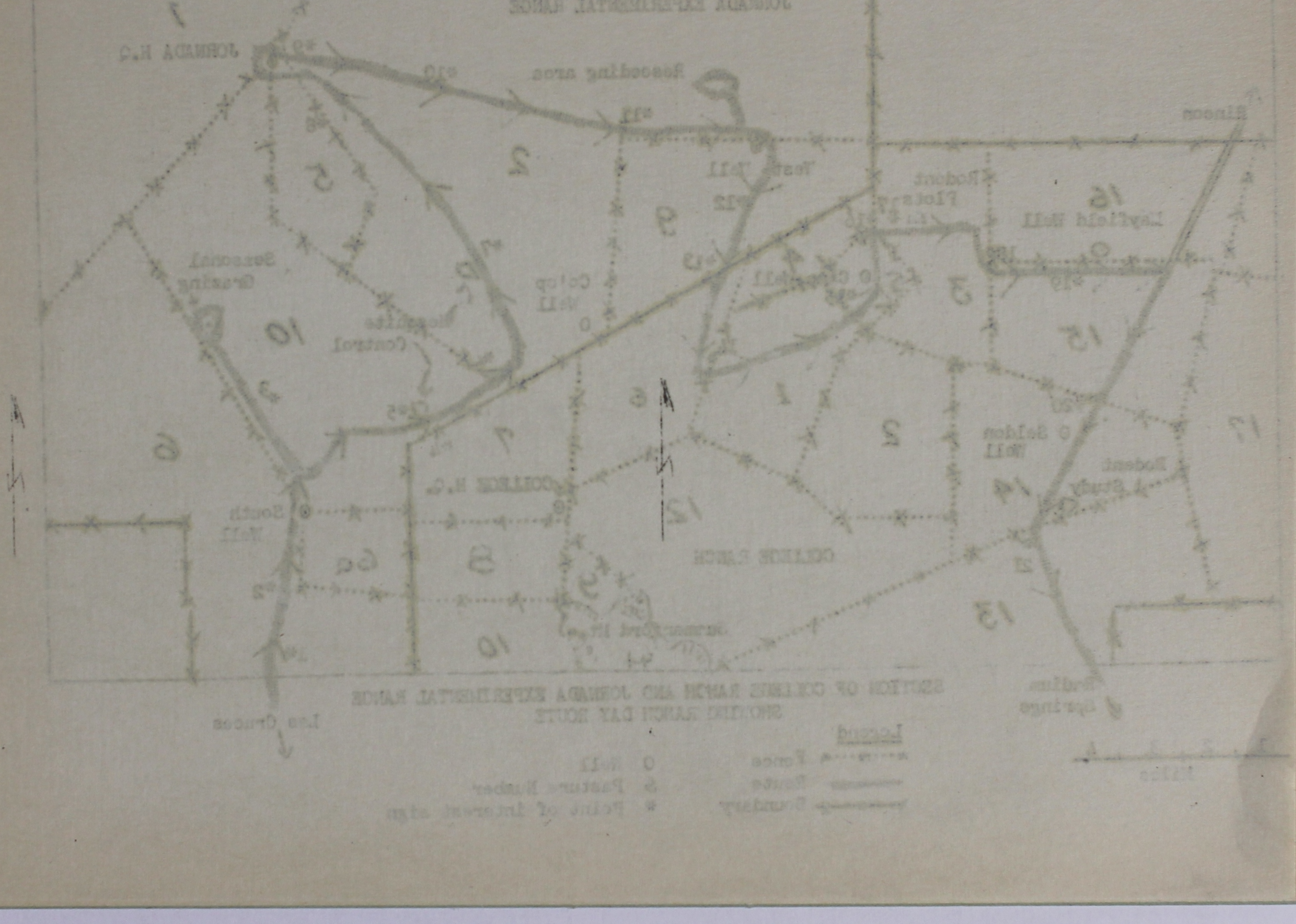
Las Cruces

SECTION OF COLLEGE RANCH AND JORNADA EXPERIMENTAL RANGE
SHOWING RANCH DAY ROUTE

1 2 3 4
Miles

Legend

Fence
Route
Boundary
0 Well
9 Pasture Number
* Point of interest sign



POINTS OF INTEREST ALONG THE ROUTE

Sign No.

1 Pasture No. 6 -- The range forage in this pasture which comprises 15,837 acres is mainly burro (Scleropogon brevifolius) and tobosa grass (Hilaria mutica). About 40 percent of the area is covered with tarbush (blackbrush) (Flourensia cernua) and creosotebush (Larrea tridentata), largely worthless for forage. Grazed mainly in the summer by replacement heifers, the average stocking has been 109 animal units yearlong or 145 acres per animal unit.

2 The tarbush demonstration area was cleared in 1936 by CCC labor. Grass production has increased threefold and plant cover increased over four times on the treated area. (1,080 lbs. green weight perennial grass per acre as compared to 327 lbs. on adjacent areas in 1945). Rate of reinfestation estimated at 25 years.

3 Pasture No. 10 (7,172 acres) -- Range forage is predominantly black grama (Bouteloua eriopoda) with sand dropseed (Sporobolus flexuosus) of secondary importance. There are a few burrograss-tobosa flats in the pasture. The pasture is not grazed during the main growth season to permit maximum growth of black grama which is reserved for winter-spring grazing. Average stocking has been 137 animal units yearlong or 52 acres per cow.

4 A. & M. Ranch Pasture No. 7 -- This pasture of 2,490 acres produces predominantly black grama forage. Grazed on a yearlong basis the stocking rate has been 23.9 animal units yearlong or 104 acres per cow.

5 Black grama range in good condition. Production of grass and livestock is at a maximum and wind erosion is cut to a minimum on range maintained in this condition. Moderate grazing use and protection during summer growth season are most valuable aids in attaining this condition. Average grass production is 468 lbs. (dry weight) per acre.

6 Pasture No. 2 -- This pasture of 32,115 acres is grazed mainly in the winter-spring season. Over two-thirds of the area is covered with the low grazing capacity mesquite (Prosopis glandulosa) sandhills. Range forage in the south end of the pasture is mainly black grama and is reserved for winter grazing use. Average rate of stocking is 218 animal units yearlong or 147 acres per cow.

7 Treatments tested on sand-dune mesquite in 1946 and 1947 included several forms and concentrations of 2,4-D applied as a foliage spray. Both water and oil solutions were used. Other tests involved the direct injection of compounds such as diesel oil and carbon disulfide into mesquite sand dunes. This year we tested 2,4,5-T, penta-chloro-phenol, and some of the di-nitro

Sign No.

compounds. Although we are still looking for an effective combination of these reagents, there is none that we can yet recommend.

8 Pasture No. 5 -- This small pasture (1,780 acres) is used for a holding trap and hospital pasture. Range forage black grama grazed yearlong. Average stocking is 20 animal units yearlong or 89 acres per animal.

9 Pasture No. 1 -- This extremely large pasture of 80,739 acres has been used on a yearlong basis continuously since the establishment of the Jornada. Range forage is mainly tobosa, black grama, chamiza (Atriplex canescens), and mixed grasses with extensive areas of creosotebush, and mesquite sandhills. The average stocking rate is 613 animal units yearlong or 132 acres per animal.

10 Mesquite sandhill natural revegetation study.-- This area of 640 acres was closed to all livestock grazing in 1931 in order to provide a large area to study: (1) the rate of range improvement by natural means under no livestock grazing; (2) the effect of rodents and jackrabbits on range vegetation. Rate of range improvement as measured by increase of perennial grasses has been negligible. There has been a marked increase in chamiza. The slow rate of recovery is attributable mainly to the presence of jackrabbits

11 Pasture No. 2 -- (See sign No. 6)

12 Pasture No. 9 -- Area 3,172 acres, predominantly black grama forage. Summer deferred and reserved for winter-spring grazing use. Average stocking rate 73 animal units or 44 acres per animal.

13 A. & M. College Ranch Pasture No. 6 -- Area 2,266 acres, mostly black grama range with small areas of mesquite sandhills and tobosa. Grazing use has been yearlong at an average rate of 21 animal units or 108 acres per unit.

14 A. & M. Pasture No. 1 -- Area 2,432 acres. This black grama pasture is one of a group of three similar sized pastures where studies were initiated to determine the effect on cattle of supplementing the range forage with minerals high in calcium and phosphorus. Findings have been published in numerous New Mexico Experiment Station bulletins. Pasture used on a yearlong basis. Rate of stocking 25.6 animal units per year or 95 acres per animal.

15 A. & M. Pasture No. 5 -- This small pasture of 640 acres is mainly black grama and is grazed mainly in the late fall for weaning calves. Average stocking 8.2 or 78 acres per animal.

Sign No.

16 A. & M. Pasture No. 4 -- Area 877 acres. Range forage, black grama. This small pasture is used as a bull pasture for the summer-fall season. Average stocking for the past 10 years 7.6 cattle yearlong.

17 A. & M. Pasture No. 3 -- Area 2,470 acres. Range forage black grama, yearlong grazing use. Average stocking for the past 10 years, 23.2 cattle yearlong.

18 A. & M. Pasture No. 16 -- Area 3,571 acres. Range forage black grama, yearlong grazing use. Average stocking for the past 10 years, 19.0 cattle yearlong.

19 A. & M. Pasture No. 15 -- Area 2,655 acres. Range forage black grama with yearlong grazing use. Average stocking for the past 10 years, 22.0 cattle yearlong.

20 A. & M. Pasture No. 14 -- 2,995 acres. Range forage black grama with yearlong grazing use. Average stocking for the past 10 years, 16.0 cattle yearlong.

21 A. & M. Pasture No. 13 -- Area 9,322 acres. Mostly creosote-mesquite sandhills type. Closed to livestock grazing since 1935.

RANGE RESEARCH OF THE SOUTHWESTERN FOREST & RANGE EXPERIMENT STATION

By C. Kenneth Pearse

Ranch Day is held each year to present some of the new research findings of the Jornada Experimental Range and the adjacent College Ranch. It also offers an opportunity to follow developments in the work from year to year. We believe these findings will be of value to stockmen and others interested in range management and development, and so are of importance to the progress of the entire Southwest.

The Southwest has changed greatly since the days of free range and the old-time cow outfits. Important progress is clearly evident, for example, in our network of roads, highways, and railroads that improved the transportation and communication facilities and marketing methods of the past. Irrigation agriculture and urban development have taken over much range lands. Range livestock production has become a permanent industry with each operation limited to a well defined range area. Each rancher now has just so much range, and his operations must be planned accordingly.

During this period of agricultural development the native vegetation on many ranges has changed. Some of the most productive, palatable, and nutritious grasses, that once grew stirrup high in places, have been replaced by less valuable forage plants and even by undesirable species, including some that are poisonous, such as bitterweed. Forage production, as a result, is considerably less than formerly, and there is a great need for and possibility of restoration.

Some characteristics of the Southwest have not changed since settlement. The climate is still dry. Droughts are frequent and severe. These conditions make livestock production the major use on 87 percent of the area and pose many problems for the rancher. Because of comparatively scanty forage, ranching is and always will be a large scale enterprise. Each cow needs from 25 to 250 acres yearlong and individual ranches must always be extensive.

As we develop further, however, more intensive land use will be inevitable. Each tract will come to be used in accordance with its highest value; cultivated agriculture, timber production, range or other correlated uses. Ranges will be more intensively managed. Each portion will be grazed by the class and kind of livestock, at the intensity and season to which it is best suited in order to maintain the highest return from each unit and to hold down costs of production. These factors must be kept clearly in focus in order to help solve some of the varied problems of the range livestock industry. This is our responsibility in the Southwestern Forest and Range Experiment Station. As the responsible authority in the Department of Agriculture, for research on range lands, our goal is to discover facts and test better range management procedures. These are designed to point the way for maximum economical production of range livestock year in and year out, to maintain or improve the range resource, and to protect other land values. The principles of range

management uncovered should form the basis for sound range use and highest maintained livestock production.

Our work falls into three principal types of studies. One of these pertains to devising better methods of grazing management. These are needed to provide the intensity of use and system of handling livestock that will maintain productivity on ranges in good condition, and improve productivity on those which are unsatisfactory. To do this, we must first know how to judge the true productive condition of the range, that is, whether it is producing as much forage as it can and should, and whether it is improving or deteriorating. Then, for each condition and type of range, we need to know the proper degree of stocking, season of use, values of rotation and deferred grazing, and how to get better distribution of livestock grazing. On some ranges other factors such as the effect of timber production or the harmonizing of grazing by game and livestock must be considered. Finally, in the light of this knowledge, as well as a knowledge of good animal husbandry practices and the economical needs of the producer, a system of management that will maintain or improve range forage production needs to be developed and applied. More information is needed before such management can be provided on most range situations in the Southwest. That real progress is being made, however, is clearly evident by the many highly productive, firmly established ranching enterprises where 1,000 pound cows and 400 pound calves are taken as a matter of course.

Most of our grazing management studies are centered at three experimental areas, the Santa Rita and Fort Valley in Arizona, and here at the Jornada in New Mexico.

Another type of study deals with finding species and methods for reseeding the more than three million acres of range lands that are so badly deteriorated that they cannot recover without artificial aid. Reseeding is needed on parts of every major range type in the region. We have had to limit our search for economical and effective procedures to the higher rainfall zones where opportunity for success appears best. Studies are showing what, when, where and how to plant on the pine-bunchgrass ranges and pinyon-juniper ranges of both New Mexico and Arizona. Rather large range areas are now being planted, based on principles developed by research. Exploratory studies are being made in the shortgrass, semidesert grassland-shrub, and sagebrush areas, but we have not been able to give these areas the study they deserve.

The third type pertains to the seeking out of economical methods for control and removal of noxious range plants. On many ranges noxious plants of one kind or another (mesquite, burroweed, juniper and cactus) are increasing and replacing valuable forage plants. Practical studies of control of these undesirable shrubs have provided the only methods now available for control of some of them. These methods are neither positive nor economical enough to be fully satisfactory, and accordingly the research on noxious range plants has recently been expanded under the Research and Marketing Act, in cooperation with the University of Arizona. These new fundamental studies should open the door to more effective control methods.

Some research on each of these three types of study is under way on the Jornada. Here we are finding specific answers to specific problems

on an experimental range representing one of the most important range areas of the Southwest, covering 26 million acres in New Mexico and west Texas. The annual rainfall in this semidesert grassland area averages about 12 inches, with only 8 inches in some places and as much as 20 in others. Its seasonal distribution favors grasses that make their principal growth during the summer. Drought is a normal part of the climate, occurring in 1 to 3 years in every 10. As a result, forage production is comparatively scanty and varies greatly from year to year.

The grazing management studies on the Jornada were started in 1915, when the area was set aside for experimental purposes. They have been continued over the years during which time several specific management tests have been made. Mr. Ares and Mr. Christmas will describe and demonstrate two current phases of this work.

The present noxious plant control and reseeding studies here are new within the past few years. They are still on a limited basis because of limited funds. However, the phases of these studies you will see will give you an insight to our method of approach as well as results to date.

THE JORNADA EXPERIMENTAL RANGE
Management, Current Range Conditions, and Seasonal Use

By Fred N. Ares

Description

During the course of the last few years, ranchers and others in this locality have heard a lot about "Proving Grounds." We here on the Jornada Range think of this setup as a proving ground also in that methods of handling livestock and range as worked out and approved here may be applied elsewhere in the vast cattle domain which is the Southwest. The Jornada is well suited for such purposes being typical and representative in topography, soil, climate and in vegetational zones, of some 26,000,000 acres located within the semidesert, low altitude regions of the Southwest.

Jornada topography varies from the gently rolling plain or mesa with an average altitude of 4300 feet, to the rugged contours of the San Andres Mountains, reaching altitudes of over 8,000 feet at the eastern boundary of the range. The classification "semidesert range" reflects the low average rainfall. Average annual precipitation is a little over 9 inches, about half of which falls in the months of July, August, and September. Drought years are very frequent, the Jornada having experienced three of varying degrees of severity within the past 7 years. Many of the important forage types of the dry Southwest are found within the boundaries of the Jornada, from the top quality black grama to the desolate mesquite-sand dune and the low value creosote and tarbush types. Thus it can be said that the results of the experimental work carried on here have a wide application on similar ranges of the Southwest.

All of the range used for grazing experiments here is owned by the Federal Government, the bulk of it having been set aside by executive order for this purpose in 1912. With the land, all improvements, such as fences, wells, surface tanks, buildings, and other installations are also the property of the Government. The cattle comprising the experimental herd are owned by Mr. B. A. Christmas, well known southwestern cowman who cooperates with us under agreement with the Secretary of Agriculture.

The range is divided into seven large and two smaller experimental units on each of which daily stocking records are kept. These units roughly divide the range into different range types and make possible the highly desirable deferred and seasonal use practices, an important part of the Jornada management plan. The continued use of this and other features of approved range practices, we believe, is responsible for maintaining the productivity and the present good condition of most of the Jornada Range.

The Jornada is watered by a system of deep wells on the yearlong range and by surface water tanks on the summer or temporary range. The wells, seven in number, average about 350 feet in depth. The 14 large

earthen tanks hold water several months and are supplemented by a large number of small tanks or water holes constructed on the summer range to aid in the distribution of livestock and bring about the full utilization of the temporary summer forage.

Management of the Range

The grazing capacity of the Jornada, determined by range surveys, supplementary studies, and by actual performance of the range under continuous use for the past 33 years, has been set at about 1200 cattle on a yearlong basis. This means that the gross surface acre requirement of this range is about 160 acres per cow yearlong, or about 4 head per section. Of course, this is the average; some of the rougher parts of the range are inaccessible, other parts are so low in productivity that they will not support even one cow per section while others have a capacity of as high as 10 head or more per section.

A principal feature of the plan of range management on the Jornada is deferred or seasonal use. The highly valuable and very productive black grama range is deferred or very lightly used during the three or four month growing season. During this season, the bulk of the experimental herd is grazed on the summer range of tobosa and burrograss forage types. These grasses are relished by cattle only when they are green and succulent and must be used before they dry. Black grama, on the other hand, cures well on the stalk and may be profitably grazed at any time of the year.

Distribution of livestock is the bugbear of desert ranges where permanent watering places must, of economic necessity, be few in number and far apart. On the summer range, distribution is aided by the small water tanks and the other water developments already mentioned, by range salting, water control and riding. On the winter range, range salting is depended upon to help secure better distribution of cattle on the range.

Management of the Herd

The plan of management in use over the past ten year period, 1938 to 1947, is believed to offer the best possibility for maximum beef production each year and for minimizing drought losses. The significant feature is that of the 1101 head grazed only 631 head or 57.3 percent were breeding cows exclusive of replacement heifers (Table 1). This low breeding cow ratio provided flexibility to the operation so that the frequent adjustments in numbers which were made necessary by drought could be made with least disturbance to the breeding herd and least financial sacrifice. During the ten year period the calf crop has averaged 83.5 percent and the death losses 1.2 percent.

In the preceding twelve year period, 1926 to 1937, the ratio of breeding cows to the total number of livestock grazed was 70 percent. This high ratio of breeding cows made it difficult to reduce the herd during drought and forced sales were frequently necessary. For example, in 1934 a large part of the breeding herd was liquidated at considerable financial loss to the operator. If the needed reduction could have been

made by sale of yearlings or other easily marketed classes of cattle, there would have been much less difficulty. During the twelve years when 70 percent of the herd was made up of breeding cows, calf crops averaged 74.6 percent and death losses averaged 2 percent. Thus, our present plan of management has yielded 11.9 percent more calves and reduced death losses by 40 percent.

As a form of "drought insurance" the Jornada management plan has worked well. Two unfavorable and three severe drought years have been encountered and passed over with no need of forced removals or sacrifice sales of breeding stock such as was the case in the past.

Jornada Production

Sales weights and prices of all cattle removed from the Jornada are an excellent index to the productiveness of the range and also to the efficiency of the present plan of herd management (Table 2). In the past decade, even though the total stocking was reduced by 11.2 percent, average annual marketings of beef exceeded that of the preceding period by over 8,000 pounds. Cash receipts per year and per cow, in terms of the average 22-year selling price, were also significantly greater. This record definitely favors the present plan with its lighter total stocking, smaller ratio of breeding cows to total numbers, and the more flexible method of handling the herd. It is noteworthy too that annual sales of beef fluctuated very little from year to year during the last decade, thus providing a sounder basis of operation with less risk from drought and the depressed market which usually accompanies it.

Current Range Conditions on the Jornada

Range and forage conditions so far this year on the Jornada Experimental Range present a tale that is soon told. It can be expressed with one word, "drought." Total rainfall received in 1948 up to September 10 has been 3.56 inches. Ordinarily, we expect about 7.50 inches or 80 percent of our average annual rainfall by this time. Furthermore, the rains have not been effective for forage growth because of the long, dry periods between storms. There has been practically no growth of black grama on the west side of the range. On the east side, where runoff from the mountains flooded small areas along water courses, a few scattered spots became green and forage grew for a few weeks. Otherwise, there has been no growth of forage anywhere on the Jornada since the summer of 1947.

Seasonal Use of Range

On ranges with areas of black grama, tobosa and burrograss types as on the Jornada, controlled seasonal grazing is needed to secure full and practical use of the forage resource as well as maximum cattle production. Seasonal use has also repeatedly demonstrated its value here on the Jornada and elsewhere by helping to restore deteriorated ranges and maintaining ranges in good condition in a high state of productivity. Seasonal grazing in simple terms is the use of each range type during the most suitable part of the grazing year. For example, black grama, because it is usable yearlong, is reserved for the critical periods of

winter and spring, being deferred or very lightly used throughout the growing season. On the other hand, the next most important forage source, mixed tobosa and burrograss, is used mostly for summer and fall grazing because the herbage is relished by livestock only when lush and green.

To illustrate the beneficial effects of seasonal use in contrast to heavy yearlong grazing, a fence line comparison site has been chosen. This line runs between summer pasture No. 6 on the north and winter-spring pasture No. 10 across the fence on the south. The fence was built about 20 years ago and instead of being run exactly along forage type lines, it followed a straight line. This resulted in about a section and a half of good black grama range being included in this part of the summer pasture. This pasture, No. 6, is used fully during the growing season, approximately from July 1 to October 31 of each year and because of the abundance of annual weeds and yucca blooms it has also been used in the late winter and early spring in most years. It, therefore, has had what amounts to yearlong use, with heavy use throughout the growing season. Pasture No. 10, on the other hand, has been grazed as a winter-spring pasture with very light additional use in the growing season. No summer use at all would have been allowed had it not been for a small area of tobosa-burrograss range on the east side. Only sufficient cattle were placed in the pasture in the growing season to utilize this forage. Temporary water is available at about equidistant points approximately 1-1/2 miles on each side of the fence from the comparison site, so that lack of water may be ruled out as a factor influencing the utilization of the range on either side.

A series of plots were laid out to measure and evaluate density, composition, and forage production on each side of the fence. In pasture No. 6, black grama and "other grasses," consisting primarily of three-awn and dropseed, make up less than one-third of the total composition, while the worthless snakeweed accounts for the remaining two-thirds (Table 3). By contrast, in pasture No. 10, grasses make up 92 percent of the total and snakeweed, 8 percent. In the pasture grazed yearlong, the black grama density is negligible, the three-awns making up most of the remainder of the grass composition.

For the deferred use pasture, No. 10, the situation is practically reversed, the minor part being played by the inferior grasses, with black grama the dominant species.

A striking contrast is found in the forage yeild of black grama and "other grasses" in the two pastures (table 4). Deferred pasture No. 10 produced 56 percent more forage than pasture 6 and 82.5 percent of this yield was made up of the nutritious black grama. Only 40.9 percent of the forage produced under heavy summer use in pasture No. 6 is made up of black grama while "other grasses" comprise 59.1 percent of the total. The yield of black grama in pasture 6, 620.7 pounds per acre, is more than 3 times the 196.8 pounds produced by pasture 10.

These data provide a quantitative measure of the difference that can be seen along the fence line. It also highlights some of the management policies followed on the Jornada Experimental Range. It is offered in the hope that it may play a practical part elsewhere in the use of southwestern ranges.

Table 1. Average stocking, breeding cow ratio, death loss, and calf crop data for two periods, Jornada Experimental Range.

Period	Adult Stocking	Breeding Cows	Breeding Cow Ratio	Calf Crop	Adult Losses
	No.	No.	Percent	Percent	Percent
1926--37	1240	868	70.0	74.6	2.0
1938--47	1101	631	57.3	83.5	1.2

Table 2. Average annual beef marketed and receipts from Jornada herd for 1926 to 1937, inclusive, and 1938 to 1947, inclusive.

Period	Average Adult Stocking	Breeding Cow Ratio	Average Beef Marketed	Average Annual Receipts*	Average Annual Receipts Per Breeding Cow
	No.	Percent	Pounds		
1926-37	1240	70.0	393,520	$29,689.87	$34.20
1938-47	1101	57.3	401,712	30,307.22	47.95

*Calculated on basis of average selling price of $7.5445 per cwt. for 22-year period.

Table 3. Vegetational composition of black grama range grazed yearlong and during the non-growing season only.

	Density (percent of complete ground cover)				
	Black Grama	Other Grasses	Total Grasses	Snakeweed	Total
Pasture 6, Yearlong Use	0.6	1.5	2.1	4.6	6.7
Pasture 10, Seasonal Use	1.8	0.5	2.3	0.2	2.5

*Principally three-awns and dropseed.

Table 4. Forage yields of black grama range grazed yearlong and during the non-growing season only.

	Forage Yield					
	Black Grama		Other Grasses*		Total Grasses	
	Pounds per acre	Percent	Pounds per acre	Percent	Pounds per acre	Percent
Pasture 6, Yearlong Use	196.8	40.9	283.9	59.1	480.7	100.0
Pasture 10, Seasonal Use	620.7	82.5	130.8	17.5	751.5	100.0

*Principally three-awns and dropseed.

THE VALUE OF EARLY MESQUITE CONTROL

By S. Clark Martin

We are now on a study area established in June of this year to determine the cost and effectiveness of controlling mesquite before it becomes too firmly established. This step was made because we believe it is a good example of the type of stand where mesquite control pays big dividends. We expect to visit this site again in future Ranch Day programs so that those of you who come here year after year can see the progress of this investigation.

There are four 10-acre tracts in this area. One of these has been left undisturbed while the small mesquite was grubbed from the other three. In order to obtain an idea of the frequency at which areas like this must be grubbed to keep mesquite from becoming a serious problem, we plan to regrub one plot in 5 years, another in 10 years and the third in 20 years.

You may wonder why we are concerned with areas where mesquite forms such an inconspicuous part of the total vegetation now and where black grama is in good vigor and apparently has control of the site. Our experience on the Santa Rita Experimental Range in southern Arizona well illustrates our cause for concern.

Early photographs taken on the Santa Rita show that many areas which are now covered by mesquite were clear enough in 1900 to permit extensive mowing of wild hay. These same areas now have stands of from 50 to 100 large trees per acre. Some of the pictures which show this change will be on display during the lunch hour.

The point we wish to emphasize here is that, in regard to the number of mesquite, this area is now very similar to what the Santa Rita was in 1900. When you come here again next year or the year after, you probably will not recognize any change at all in the size and number of mesquites. The same was true on the Santa Rita in the early days. However, when the small yearly increases in mesquite are added together for a long period the change is striking. Over a 30-year period a yearly increase of three plants per acre will produce a 90-tree stand. At present there is no economical method for clearing land such as this, once it has reached the large dune stage, but the annual grubbing of from 2 to 5 seedlings per acre may prevent it from ever becoming a mesquite-dune desert.

You all know that the tree form of mesquite has some forage value, that it offers shade for cattle in the hot summer, and that the wood is useful for fuel and posts. Such being the case you may wonder whether mesquite increase on the Santa Rita was good or bad. Comparison between early and recent pictures and records indicates that there has been a pronounced decrease in the density of perennial grasses that has coincided with the increase in mesquite. Furthermore, by removing the mesquite, perennial grass production has been doubled and production of annual herbage increased as much as 5 times. Measurements of the quan-

tity of forage produced by mesquite beans and leaves indicate that these items amount to much less in total feeding value than the perennial grass production which is lost because of mesquite. Santa Rita stocking records also reflect the increase in mesquite at the expense of more productive vegetation. For example, one pasture was stocked at the rate of 32 cows per section from 1917 to 1926. From 1939 to 1948 this pasture has carried only 22 head per section. On the basis of our average production and assuming a market value of 25 cents per pound for calves, this loss of 10 head per section is costing the cattleman about $1.22 per acre per year. Although recent drought years have had their toll, there can be no doubt that the reduced grazing capacity is due in part to the increase in mesquite. In fact, mesquite magnifies the effect of drought by consuming a major part of the soil moisture that would normally be used by grass. Graphic proof of the detrimental aspects of mesquite can be seen in some of the photographs which will be on display at the Jornada headquarters.

To grub the small mesquite from 30 acres at this site last June cost 48 cents per acre with 80 cent per hour labor. Because of the relatively large amount of time spent in walking from one plant to the next, the cost per plant for grubbing light stands such as this is high (12.5 cents). If such plants were grubbed whenever they are encountered in regular range riding the cost per plant probably would not exceed 2 or 3 cents.

For comparison with this stand of fewer than 5 plants per acre we also established a similar study area where there are 144 mesquites per acre. Although the cost of grubbing each plant in the dense stand was only 2.5 cents, the cost per acre was $3.81 or almost 8 times as great. The point we wish to emphasize by this comparison is that if a 50 cent per acre job of clearing is done early enough, and is repeated from time to time, a $4.00 per acre job will never be necessary. Remember, that like rabbits, the more mesquites you have the more rapid will be their increase.

We have drawn heavily on data from the Santa Rita Experimental Range to illustrate the mesquite problem here. Since this is the case, it would not be fair to end this discussion without pointing out a few fundamental differences between conditions on the two experimental ranges. Four points which indicate that early control is even more imperative here than on the Santa Rita are: (1) Sand dune mesquite has a low forage value, does not grow to fence post size, and is poor source of fire wood. Consequently, the compensating values of dune mesquite are much lower than those of tree mesquite. (2) Even in dense mesquite stands on the Santa Rita there are remnants of perennial grasses beneath the trees. These grasses respond immediately to mesquite eradication. Here, in the well developed mesquite sand dune type there are very few perennial grasses left. (3) The soil on the Santa Rita is fairly stable, making it possible to kill mesquite without creating an erosion hazard. Here, if the mesquite is killed in the dune type, there is nothing left to stabilize the soil and it is very hard to establish grass in the shifting sand. (4) The tree type of mesquite such as occurs on the Santa Rita can be killed with oil or with sodium arsenite at costs that are not exorbitant on the better types of land. There are no reliable chemical

methods yet developed for dune mosquito and mechanical removal of dunes is impractical because of the high cost and the hazards of wind erosion.

Our hope in presenting this material is that some of you who have ranges where mosquito is not yet out of hand will get some sharp mattocks for your cowboys and get busy.

The best and cheapest way to kill mosquito on your range now is to grub them while they are small and scarce. If you wait too long, they'll outnumber you.

CHEMICAL MESQUITE CONTROL

By S. Clark Martin

The goal in chemical mesquite control is to develop an economically practical "one shot" method that will kill the top growth and prevent sprouting. Killing the top growth with chemicals is comparatively easy. Finding a cheap reliable method for preventing sprout development is more difficult.

Most of our work has involved the use of one or more of the following types of compounds: (1) water soluble inorganic poisons such as sodium arsenite, (2) oils - either with or without added oil soluble poisons, and (3) the relatively new hormone type of organic chemicals such as 2,4-D. We have selected the most promising chemicals from these classes and tested them in various combinations as killing agents for mesquite and other woody range weeds. Most of our work on mesquite has been on the tree form with only a little testing on dune mesquite. By this "cut-and-try" type of research we have developed reliable methods for killing tree mesquite with sodium arsenite and oil. We have also killed a few mesquite with 2,4-D but our overall results with this type of compound have been poor.

Sodium arsenite: Sodium arsenite is extremely poisonous and must always be handled carefully to avoid injury to workers and livestock. However, if handled with the proper precautions the hazard involved is slight. The addition of a strong dye is a valuable safety measure.

Sodium arsenite travels readily in the sap of the mesquite tree and is very toxic to plant tissue. From these standpoints it is a very desirable poison. It is best adapted for use on the tree form of mesquite, but can be used on shrubby forms where the root crown is relatively close to the soil surface. For trees, a solution containing not less than 3 pounds of arsenic trioxide per gallon of water is usually applied to freshly prepared girdles made as close to the soil line as possible. On the shrubby form it is best to cut the tops off just above the root crown and paint the stubs with sodium arsenite. Better results are obtained if the poison is thickened with laundry starch.

For plants of the tree form which are too small to girdle the basin method may be used. In this method a small depression is made around the plant base and filled with sodium arsenite. The basin method requires much more poison than the girdling procedure and renders a small spot of soil around each tree sterile for a number of years.

Killing mesquite trees by girdling and poisoning with sodium arsenite costs about 7 cents per tree. Two cents of this cost is for sodium arsenite at 90 cents per gallon for 4-pound solution. At 80 cents per man hour the labor cost for girdling a mesquite tree and applying the poison is about 5 cents.

Because of the poisonous properties of sodium arsenite we do not recommend its use except in those cases where it shows a distinct advantage over oils in cost or effectiveness.

Oils: In contrast to sodium arsenite, oils may be used without danger of poisoning livestock or workers. The main danger involved in the use of oils is from fire.

Oils also differ from sodium arsenite in that their effect is local. Oils do not mix with the plant sap and travel with it, and in order to be effective they must be carefully applied. Practically all of the light or thin petroleum products such as kerosene and diesel oil contain enough toxic agent to kill mesquite. The addition of a small amount of waste crankcase oil to kerosene or diesel oil is permissible if too much is not used. Too much heavy oil thickens the light oil so that it will not readily soak into the soil. For oils to kill they must soak deep enough to come in contact with all sprout buds.

Oil must be applied to all sides of the tree and in sufficient quantity to saturate the soil to the level where the uppermost large lateral roots are found. The best method for applying oil is to pour or spray it against the bark of the tree just above the soil line. When carefully applied, oil is equally effective against standing trees, freshly cut stumps, or sprouting stumps.

Oil is most practical for the tree form of growth on soil that is not too fine, and where sedimentation has not been great. Where oil treatment is recommended, one gallon is enough for from 5 to 7 average trees. The present total cost per tree at this rate is about four cents. This cost is equally divided between labor at 80 cents per hour and oil at 11 cents per gallon.

2,4-D compounds: Since the close of the war, the hormone type of weed killers which are mostly derivatives of 2,4-D have received much attention. They are now being used very effectively in the control of many herbaceous plants and many forms have been tested on woody plants. The chief advantages of these hormone weed killers are that they are practically nonpoisonous to animals, they are much more toxic to non-grasses than to grasses, and they are effective in very low concentrations and are therefore relatively inexpensive.

We have tested many different forms of these compounds on mesquite at the Santa Rita Experimental Range and a few here. Generally speaking, the results have been erratic and the actual kills have been very poor. Some preparations will kill mesquite top growth but none has consistently prevented sprouting. We have found that oil solutions of the hormone preparations are more toxic than aqueous mixtures, that higher concentrations are required for woody than for herbaceous plants and that a new and closely related substance, 2,4,5-T, is apparently more effective than 2,4-D. At present we cannot recommend any of these compounds for practical mesquite control. We will continue to test them, as well as any new related compounds that may be developed, because we feel sure that they will play a part in wide scale economical control that will some day be possible.

SHRUB CONTROL STUDIES UNDER THE RESEARCH AND MARKETING ACT

By George E. Glendening

After the remarks which you have just heard, I don't believe it is necessary to tell you that a significant amount of progress has been made during the past 10 years with regard to the use of chemicals for the control of noxious plants. New and better chemicals and new and better methods of applying these chemicals have been developed, mainly through repeated testing and observation of the results obtained. In spite of this progress, actual field eradication practices are still costly, and much more effective and economical methods than we have developed so far will be necessary before control or eradication of all troublesome shrubs can become an accepted fact on range lands of only moderate or low grazing capacity.

The killing of these aggressive and often large woody plants, and prevention of invasion of these plants is a tremendous problem, and is going to require more than hit or miss methods. Our studies have shown that the development of practical methods for controlling undesirable plants on range lands has been hampered by a lack of concrete information regarding the life history, the capabilities, and the growth requirements of the specific plants concerned. Some stockmen and ranchers have also recognized this. It is fortunate, therefore, that a small fund to begin the necessary type of basic studies has recently been provided under the Research and Marketing Act. Although our project is just getting underway, we thought you would like to know how the work is organized. and a little bit regarding the kind of studies on which we are focusing our attention.

How the Research and Marketing Act functions:

The Research and Marketing Act was passed by Congress in August 1946. All research funds authorized under the Research and Marketing Act are specifically earmarked for new research in agriculture. This new research is intended to "assure agriculture a position in research equal to that of industry." The money allotted to the Southwestern Forest and Range Experiment Station in late 1947 is designated for basic research on control of noxious range plants in the Southwest. The studies are to be conducted in cooperation with the various State Agricultural Experiment Stations. At present we are working in Arizona, in cooperation with the University of Arizona Agricultural Experiment Station which has conducted some important research on noxious plants. The Southwestern Forest and Range Experiment Station is providing the personnel, the field equipment and the necessary supplies. The University of Arizona Agricultural Experiment Station makes available any necessary special laboratory facilities, and their specialists in plant physiology, plant anatomy, plant chemistry, and soils provide technical advice on any particularly knotty problems which turn up in our studies. We feel that this arrangement is very desirable, and that it will result in a sound, effective and economical type of research program. We hope funds will be allotted to extend the studies to New Mexico and West Texas.

The empirical type of studies which we have been conducting in the past, and which are aimed at testing and evaluating of various chemical and mechanical methods of control under actual field conditions, will be continued. Our new basic research will be closely integrated with these studies, and when any promising new leads are developed, they will be given practical field tests.

Present research program:

So far we have concentrated our work on mesquite in Arizona. Mesquites now occur on more than 50 million acres of range land and are causing economic loss on many ranches in southern Arizona, southern and eastern New Mexico, and western and central Texas. Mesquite was selected for study after a careful overall analysis of the noxious range plant problem in the Southwest. This analysis also showed that there is equal need for basic research on several other undesirable plants, especially junipers and cactus. As quickly as possible the program will be expanded to allow for the necessary basic work on those plants.

From past studies of mesquite and experience obtained in actual control and eradication work we know that killing of mesquite by chemical means requires that the poison material be absorbed by the tree and carried to all the active and potentially active growing points or buds. This requirement holds whether the chemical is applied to the soil, the base of the tree, or to the leaves, and so far we have had difficulty in getting most poisons to move freely in a mesquite tree. Consequently, we are conducting studies to determine the rate and pattern of movement, within the mesquite tree, of various materials including sodium arsenite, 2,4-D, 2,4,5-T, and other promising herbicides. We are also determining how the movement of these killing agents is affected by temperature, humidity, and soil moisture, and the specific amount of the various chemicals which must be brought in contact with the dormant basal stem buds to prevent sprouting. These investigations should have practical value by indicating the stage of growth or season of the year at which chemical treatments should be made, the best method for getting the poison into the trees, and the minimum amount of toxic material that will result in a complete kill.

Control of mesquite reproduction from seed and the prevention of a reinvasion on areas where the mature trees have been removed or killed promises to be of equal importance to the eradication. Detailed counts show that not less than 416 new seedlings per acre emerged on parts of the Santa Rita Experimental Range during the past summer. These young seedlings will not all live to become large trees, since they are susceptible to drought, and in addition are already being grazed by rabbits, rats and insects. However, if only ten percent of them become established, it will mean enough new mesquites to profoundly change both the appearance of the landscape and the land values. We are following these 1948 seedlings under different site conditions and under different degrees of grazing by rodents and livestock to determine relative survival and establishment. We are determining the amount of viable mesquite seed present in the soil under tree stands of varying densities, how these seeds are disseminated or

distributed over the area, and how long such seeds remain viable under natural conditions. Other studies aimed at determining how and why mesquite invades and becomes established, and the rate at which the invasion takes place under different climatic and soil conditions are to be initiated.

Results so far obtained:

Since our studies are new, many of the results obtained must be considered tentative. Findings which now appear to be most significant are as follows:

When various chemicals are directly injected under the bark of a mesquite tree, the rate of intake of the solution is effected to a significant degree by season of the year, time of day, and type of material injected. Thus, prior to the summer rains in July, while soil moisture was unavailable and water in the trees was very limited, the poisons were taken in more rapidly during the hot dry afternoon period than during the cooler and more humid early morning hours. During late August, when the soil was moist and water was available to the trees, solution intake was greater than during July and was equally rapid during morning and afternoon. These results indicate that treatment of mesquites with chemicals should give best results after the summer rains have started. Also, that if treatment is applied prior to the summer rains, the hot afternoon period is best.

Of six solutions tested, sodium arsenite which rapidly kills plant cells is taken in at the slowest rate, and the rate of intake drops off rapidly after a few minutes. Solutions of the hormone type poisons (2,4-D and 2,4,5-T) are taken in in significantly greater quantities, and the intake continues at a more or less uniform rate for at least 48 hours. These results which indicate that 2,4-D and 2,4,5-T may move freely within a mesquite tree and not cause any immediate injury to the plant cells are encouraging, because this type of movement is going to be necessary if mesquites are to be killed by use of a foliage spray.

Observation of injected dyes showed that there is very little lateral or transverse movement within the mesquite. Upward movement in the new wood, however, was very rapid, being about 78 inches in 1 minute. Downward movement was negligible during July and only about 3 inches per minute in August.

The results of detailed counts of new seedlings on the Santa Rita Experimental Range are rather striking. Thus, where cattle and rabbits were excluded, there were 23 seedlings per acre or 0.7 seedling per seed bearing tree; where cattle only were excluded, there were 129 seedlings per acre or 2.9 seedlings per seed bearing tree; and on areas grazed by cattle and rodents there were 270 seedlings per acre or 6.6 seedlings per seed bearing tree. The extent to which the processes of germination and emergence of mesquite seedlings may be affected by grazing is not definitely known, and it may be that these differences in number of mesquite seedlings are a relative measure of the amount of seed present in the soil.

Many cases of multiple emergence (more than 1 seedling on a single spot) were noted in our observations made during the past July and August. Cases where 3, 4 or 5 seedlings emerged in one spot were common, while in two cases 13 seedlings were found on spots less than 2 inches in diameter. These multiple emergences are probably the result of seed caches made by rodents. The influence of rats and mice in distributing and scarifying mesquite seed has not been thoroughly investigated and will be studied further, since there is strong evidence that the germination of mesquite seeds buried by rodents at some previous time may be a factor in the rapid spread of this plant on range lands.

Because they have been at it for a much longer time, farmers have developed effective methods for controlling weeds on crop lands. Much of the progress in weed control during the past few years has resulted from studying the fundamental life processes and requirements of specific problem plants. The Research and Marketing Act noxious plant control project has allowed us to begin such studies of mesquite. With the improvement in plant poisons and in equipment for applying these poisons, better and more practical methods for controlling or eradicating mesquite should be produced. Also, with a better understanding as to how and why mesquite and other noxious plants come in and become established on range lands, it seems reasonable to expect that part of the invasion, at least, may be prevented without the need for artificial control methods.

RESEEDING RESEARCH--A BROAD PROGRAM FOR THE SOUTHWEST

By Hudson G. Reynolds

Many ranchers are justly interested in improving range lands. Land capable of but not producing high quality forage is a liability. While artificial reseeding cannot offset overstocking or poor management, it does offer a hopeful aid for restoring palatable plants on deteriorated ranges. For example, at Jarita Mesa in northern New Mexico, certain formerly productive meadows now yield only 80 pounds of forage per acre. The second year after reseeding, forage yields of crested wheatgrass on these sites amount to 2,500 pounds of herbage per acre.

Many range areas throughout the West can and should be reclaimed by artificial reseeding. Of the 728 million acres of grazing land in western states about 80 million acres are estimated to be in such poor condition that artificial reseeding will be necessary to restore them to their former grazing capacity. In the Southwest, 2,300,000 acres in Arizona and 580,000 acres in New Mexico are in need of reseeding. Artificial reseeding is proving to be a practical means of restoring these depleted ranges. Over 5,000,000 acres have been reseeded successfully in the West. Of this acreage, about 100,000 acres have been planted in Arizona and New Mexico.

Successful reseeding depends upon the use of proper plant species and development of satisfactory planting methods. Some reseeding information has been made available as a result of limited experimental work in Arizona and New Mexico. As early as 1895, the U. S. Department of Agriculture, Division of Agrostology (now Bureau of Plant Industry), in cooperation with the Agricultural Experiment Stations, began testing the usefulness of native and introduced plants which appeared at the time to have reseeding possibilities. The U. S. Forest Service followed up these early leads by establishing small experimental reseeding plots on southwestern national forests during the years 1910 and 1911. Agricultural experiment stations continued limited reseeding trials from 1916 to 1931, in spite of inadequate funds and personnel. During the National Recovery Program from 1933 to 1942, considerable impetus was given to reseeding because of the funds available for conservation work of this kind. Several thousand acres were planted by CCC employees. These plantings were necessarily of an exploratory nature since so little was known of proper procedures or practices for reseeding in the Southwest. These earlier attempts at reseeding were largely unsuccessful because of insufficient funds for developing information on where, when, how, and what to plant on an extensive basis.

Recently, in 1945, limited funds were made available to the Southwestern Forest and Range Experiment Station for undertaking a reseeding research program. The main objectives of this undertaking are to find procedures for increasing the grazing capacity of range lands, stabilizing the soil where erosion is occurring, and developing special uses for reseeded species for the ranching industry.

Opportunities for increasing grazing capacity where good soil and rainfall exist are high. At Jarita Mesa in northern New Mexico, grazing capacity has been increased from 20 acres per cow month to 1 acre per cow month within 2 years after reseeding. At Cebolla Mesa 1 year after reseeding former sagebrush lands are producing 2.5 acres per cow month of potential grazing, whereas the undisturbed sagebrush areas are producing only 25 acres per cow month of grazing.

In many areas where deep gullies are rapidly encroaching upon the basic soil resource, artificial reseeding can be employed to restore a protective plant cover. A vegetation cover lowers the force of runoff, prepares the soil to take in maximum amounts of rainfall, and helps to prevent rain from beating particles in exposed soil into solution.

With more knowledge of species and their particular growing characteristics and nutritive qualities, special uses for reseeded stands can be developed. For example, green forage is often desired for calving and lambing areas early in the spring. Perhaps cool season plants, such as crested wheatgrass, or plants which respond quickly to spring showers, such as Lehmann's lovegrass, can be seeded in special pastures to meet these needs. The possibility also exists that reseeded species can be used to correct seasonal deficiencies of protein and vitamin A which occur during certain seasons of the year in some areas. Reseeding might thus eliminate the necessity for some supplemental feeding.

To obtain the greatest returns from the limited funds available, the reseeding research program now being conducted by the Southwestern Station was organized on an extensive basis. The States of Arizona and New Mexico were divided into several large reseeding zones having similar climatic characteristics. Areas representative of the growing conditions within each zone were then selected. This procedure allows the application of results obtained on these representative areas throughout a particular zone.

Two general types of research are being pursued. Species and techniques developed in other areas of the West are being tried for applicability to southwestern conditions. Adaptable reseeding recommendations can thereby quickly be made available. At the same time, more fundamental work concerned with specific reseeding problems of the Southwest is being conducted. This latter work will help to develop a sound foundation for future reseeding recommendations.

The major problems being undertaken by the Southwestern Station are: (1) a search for plant species adapted to various growing conditions; (2) a testing of different methods for economically establishing adapted species; (3) an appraisal of indicators by which to judge the reseeding possibilities of a site; and (4) an evaluation of the value of reseeded plants for livestock grazing.

In determining plant adaptability, more than 200 species have been handplanted in small rows at the various experimental areas. Species that appear promising are then seeded on plots about 1/4 acre in size. These plantings are protected from rodents, and special cultural techniques, such as ideal seedbed preparation, are employed to give the

stands every opportunity to become established. The plant species which survive this test are then planted in larger plots from 10 to 40 acres in size. The same equipment and procedure which are recommended for large-scale plantings are used on these latter plots. In reality, they are small-scale range plantings. A plant species which withstands this battery of tests is considered adapted for range reseeding.

Closely allied to the search for adaptable plant species is the problem of developing new species of range plants by selection and breeding. Such work is being conducted cooperatively by the Bureau of Plant Industry. The Southwestern Station tests newly developed strains of plants under range conditions and selects promising native plants for improvement. The possibilities of improving grass characteristics are great. The difference between present species and possible improvements is as great as that between Texas longhorns and today's Herefords. Such qualities as greater leafiness, longer period of growth, cold, disease, and drought resistance, higher nutritive qualities, and better seed production are all possibilities. Moreover, indications are that plant improvement work can also increase ease of establishment and forage production and generally extend the usefulness of a species.

Effective reseeding on a large scale requires that special equipment be developed and that the cost of reseeding be kept to a minimum while success of establishment is maintained. Farming equipment is seldom of heavy enough construction to stand up under the rugged conditions encountered on range lands. The Equipment Development Laboratory maintained by the U. S. Forest Service in Portland, Oregon, is concerned in part with improving old and designing new reseeding equipment for range lands. Suggestions for special equipment needed for southwestern range conditions are made to this Laboratory.

Successful stands of grass can be realized only if seed is planted at the proper depth, rate, and time. Tests are being conducted to determine the best approach to each of these problems.

Certain sites have better reseeding possibilities than others. Although it is comparatively easy to select the best and the poorest areas for reseeding, there is much to be learned about what can be expected when intermediate areas are reseeded. Climatic characteristics, soil conditions, and remaining vegetation can be used as indicators for judging the reseeding possibilities of a range. Studies are being conducted to determine how best to use these factors in determining where to reseed first.

To be of maximum usefulness for the livestock industry, a reseeded stand must furnish palatable, nutritious forage. Accordingly, each species which appears to have reseeding possibilities is subjected to grazing trials. Plants are evaluated in terms of best season of use, degree of use which can be endured, and amount of readily available nutrients produced. Measurements are recorded in live weight gains of livestock over an extended grazing period.

Another important question is whether or not reseeding will pay off. Studies are being conducted to answer this question for the Southwest.

Reseeding is "paying off" in other western regions, and it seems reasonable to believe that reseeding will pay its own way in the Southwest. In other areas in the West, returns of 25 to 50 cents per acre annually are compensating reseeding costs as high as 4 to 6 dollars per acre. With such returns, only a few years are required to pay off the initial investment. Thereafter, a handsome profit is realized.

Thus far less than 4 percent of the range land in Arizona and New Mexico in need of restoration by reseeding has been planted. With persistent research and continued practical testing on range lands by interested individuals, faster progress will be made in improving ranges in Arizona and New Mexico by artificial reseeding.

RESEEDING NEW MEXICO RANGES

By H. W. Springfield

Reseeding problems in New Mexico are similar to those in other western States. One of the greatest problems in trying to give directions for reseeding is the wide variation in growing conditions. Ranges in need of reseeding occur from the semidesert grassland in the South to the shortgrass plains in the East, and to the woodland, sagebrush, and pine ranges in the North. Topography and soil are highly variable. Average annual rainfall varies in these vegetation zones from about 8 to 30 inches. Within any one year the seasonal distribution of rainfall shows marked variations. Long-time weather records indicate July and August to be the months with highest rainfall, but during many years these months are below normal.

This year has been a good example of how misleading weather averages can be. After a wet winter and fairly moist spring, some ranges and reseeded stands were green going into summer. But the summer has been disappointing. Native ranges and reseeded stands alike have suffered.

The stand of lovegrasses before you was planted in June 1946. Last summer and this summer have been dry. Maybe it doesn't look like much of a stand to some observers, but we think it is fully satisfactory for a 2-year-old stand on this range. Compare it with the outside area. Given a couple of more average rainfall summers, it should develop into a rather high producing stand of grass.

In some parts of the State reseeding practices have not been established, and in such places management must carry the load until reseeding research makes further progress.

Reseeding is a somewhat drastic means for range improvement. It has been likened to surgery in the medical profession. Some doctors maintain that the human body has a high potential for self-recovery and that surgery should be resorted to only when all else fails. Likewise, reseeding should be resorted to only when the range lacks the potential for self-recovery aided by proper management.

If management alone is not enough and if reseeding is deemed practical, then the rancher should ask the following questions: Where? What? When? and How? — should I reseed.

The following answers may prove helpful.

Where?

Select an area where correct management is possible where the reseeded stand can be rested from grazing for at least a year. Select an area where the land is level or nearly so, such as valley bottoms or mountain parks. Best soils are deep, dark-colored, and friable, not too coarse or rocky, well drained and do not puddle. Old bed

grounds, holding traps, and abandoned farm land usually offer favorable opportunities for reseeding.

What?

Plant adapted species. The demonstration at headquarters displayed species which appear adapted to different parts of the State. Briefly,

In the ponderosa pine type plant smooth brome, orchardgrass, and tall oatgrass on the more moist sites. On the drier sites plant slender wheatgrass, intermediate wheatgrass, and mountain brome.

On Jarita Mesa, the only study in the pine type in New Mexico, several other species are showing promise: Big bluegrass, Siberian wheatgrass, tall wheatgrass, Idaho fescue, sheep fescue, mountain rye, and alfalfa.

In the sagebrush type the wheatgrasses appear best adapted with crested leading in the field.

In the Adaptation Study at Costilla south of El Vado Dam, intermediate and tall wheatgrass also show promise.

At Taos Junction western wheatgrass, blue grama, and Columbian needlegrass look best, and at Taos, chamiza and sand dropseed.

In the pinyon-juniper type at elevations from 6,000-7,500 feet and where the rainfall is from 14-18 inches, the principal adapted species are crested wheatgrass, western wheatgrass, and sand lovegrass.

On Glorieta Mesa Ree-wheatgrass and mountain rye look good. Among the nongrasses chamiza, sanfoin, and yellow sweet clover are best.

Near Corona the outstanding species is spike muhly. Other promising species are weeping lovegrass, blue grama, sand dropseed, yellow beardgrass, and chamiza.

At Monica, on the edge of the Augustine Plains, spike muhly, plains lovegrass, and sand lovegrass look good. Here crested wheatgrass has rather low vigor, but still it may have a place in the reseeding picture. Last April and May at Monica and Corona the crested wheatgrass was green and succulent, the leaves 3 to 4 inches long, whereas the native grasses were making no growth. For these and similar areas crested wheatgrass planted in small holding traps for use as spring calving or lambing grounds might prove to be a valuable asset.

The two other studies in the pinyon-juniper type were installed in July 1947 and hence give only indications. At Ft. Bayard, near Silver City, the best species are Ree wheatgrass and crested wheatgrass. Chamiza and poorland wheatgrass look best at the Rio Puerco study.

In the shortgrass type in eastern New Mexico, the outstanding species are blue grama, sideoats grama, weeping and sand lovegrasses.

Reseeding in the southeastern portion of New Mexico appears hazardous. In the Adaptation Study near Roswell a few plants of Boer lovegrass are all that have survived the dry summers of 1946 and 1947 and the cold winter of 1947.

Here in the semidesert grassland the adapted species are Lehmann's and Boer lovegrasses. In the 5-acre enclosure before you both species are growing. Weeping lovegrass is adapted to swale areas.

When?

For most of New Mexico July is the best month for planting. Most of the State is characterized by a dry spring and early summer followed by a wet July and August. Plantings made in early spring usually succumb to the extended dry period before the rains come. Fall plantings are likewise risky; if plants germinate before winter sets in, there is usually a heavy loss of seedlings from frost heaving. Spring plantings are generally best in eastern New Mexico.

How?

Prepare the ground for planting. This means removing any competing vegetation and leaving the soil in a friable condition. Methods vary with the type of vegetation. For example, here a disk was used to prepare the seedbed. The disk removed the annual weeds and also loosened the top layers of soil for planting.

In deteriorated shortgrass the disk plow has prepared the best seedbed. Two other methods which show promise for reseeding in grassland are listing on the contour and pitting the soil with an eccentric disk.

The wheatland plow has proved most practical for preparing deteriorated sagebrush range for reseeding.

Plant good seed. That is, plant seed having high germination and high purity.

Plant seed properly. Grass seeds should be planted at 1/4 to 1 inch. 1/4 inch for lovegrasses and 1/2 to 1 inch for wheatgrasses.

Plant seed at the proper rate. The rate will depend upon the purity, the germination, and size of the seed.

Here the seed was broadcast at the rate of 1 pound to the acre and was covered with a cultipacker. The cultipacker served two purposes: first, it served as a precaution against covering the small lovegrass seeds too deeply; and second, firming the soil aided in conservation of soil moisture in the top layers of soil.

Where the land is not too rough, the single disk grain drill has given the best results. Broadcasting the seed and covering it with a spiketooth harrow has proved satisfactory wherever a good seedbed has been prepared.

Where the soil is subject to blowing, for example on the eastern plains, drilling into a stubble mulch is advisable.

Management of the reseeded stand, once it is established, is essential. Little is known, however, about the grazing capacity, the grazing resistance, or nutritional qualities of the various reseeding species grown under the conditions found in New Mexico.

This fall a preliminary grazing study was conducted on Glorieta Mesa. Crested wheatgrass was grazed at light, moderate, and heavy intensities. Next year the study will be continued and a comparison made between spring and spring-fall use.

Remember, reseeding is new, so don't expect miracles from it. Anyone who reseeds should do all he can to take the gamble out of it. If he uses the best information to be had on where, what, when, and how to reseed, his chances for success are good.

COMMON AND SCIENTIFIC NAMES OF PLANTS MENTIONED

Common Name	Scientific Name
Crested wheatgrass	Agropyron cristatum°
Tall wheatgrass	A. elongatum
Intermediate wheatgrass	A. intermedium°
Ree wheatgrass	A. intermedium Ree•
Siberian wheatgrass	A. sibericum°
Western wheatgrass	A. smithi°
Slender wheatgrass	A. trachycaulum°
Poorland wheatgrass	A. trichophorum
Yellow beardgrass	Andropogon ischaemum
Tall oatgrass	Arrhenatherum elatius°
Chamiza	Atriplex canescens
Blue grama	Bouteloua gracilis°
Sideoats grama	B. curtipendula°
Mountain brome	Bromus carinatus•
Smooth brome	B. inermis•
Orchardgrass	Dactylis glomerata°
Boer lovegrass	Eragrostis chloromelas
Weeping lovegrass	E. curvula°
Plains lovegrass	E. intermedia
Lehmann lovegrass	E. lehmanniana°
Sand lovegrass	E. trichodes°
Idaho fescue	Festuca idahoensis
Sheep fescue	F. ovina°
Alfalfa	Medicago sativa°
Yellow sweet clover	Melilotus officinalis°
Spike muhly	Muhlenbergia wrighti
Sanfoin	Onobrychis spp.
Big bluegrass	Poa ampla°
Mountain rye	Secale montanum
Sand dropseed	Sporobolus cryptandrus°
Columbian needlegrass	Stipa columbiana

°Indicates that seed of these species is available from commercial seed houses.

THE INFLUENCE OF BULLS ON THE WEIGHT AND GRADE OF CALVES

By Marvin Koger

The cattle on the college ranch have been pasture-bred since 1935 so that the parentage of each calf born since that time is known. Records are kept on each animal at various ages, therefore, it is possible to determine the merit of calves sired by the various bulls. We have been particularly interested in the data which have accumulated on this point because the information is used to determine which bull will be used as the main sire on the purebred herd maintained at the college.

The records of bulls with 2 or more years calf crop since 1944 will be used to illustrate the degree to which bulls influence the weight and grade of calves at weaning, and how consistent a bull's records are from year to year. Some bulls will be on display at Ranch Day, along with their production histories.

The average yearly weight of calves sired by the various bulls is shown in Table 1. The weights are expressed as a percent of the average for the year, after certain corrections which will be explained later, were made. The data is presented in this form because weights vary greatly from year to year with the feed supply, and the percentage figures are easier to compare. A value of 100 represents average.

The data show that the average weight of calves by the different bulls varied from approximately 95 to 103 percent of average. This amounts to a difference of 33 pounds between weight of calves by the highest and lowest producing bulls. This difference is highly significant.

In general, if a bull was distinctly below average for one year, he tended to remain low during all years. There is considerable consistency in the performance of a bull from year to year. The only marked exception is the record of Bull No. 8, which has an explanation. During the first two years he was mated to unselected cows and sired calves above average in weight. For the last two years he has been mated to small, compact cows which raise calves smaller than average regardless of the bull. A lesser discrepancy is noted in the last record of Bull No. 7. It occurred when he was used in a better than average pasture.

Thus, with the records which we have available, it is possible to show a significant difference in the weaning weight of calves from different bulls. While the various bulls may change their rank slightly from year to year, a group of 15 to 20 calves will point out an unusually good or poor producing bull.

While the ability to show differences in weights of calves from different bulls is important in experimental work, few stockmen will

have records complete enough to show these differences at weaning age. It is necessary to standardize weaning weights for several factors before any significant or reliable differences in bulls can be shown. First, it is necessary to have weights of the calves at a constant age. This entails weighing the calves at a given time or age, or else correcting the weights for differences in ages at weaning. Second, the sex of the calf must be considered. At the college ranch, steer calves weigh an average of 30 pounds more than the heifers, and difference in the proportion of the sexes in the different sire groups must be taken into account. Third, the age of the dam influences the weight of calves, and weights have to be standardized to a standard age of dam. A bull mated to heifers would be at a disadvantage if his calf weights were compared directly with calves from mature cows. Fourth, the different bulls must be mated to cows of the same potential production capacity if comparisons are to be made directly. At the college, the previous history of the cows is known and the value for the bull is corrected if he happens to be mated to cows that are usually above or below average.

The weaning grades of calves from the various bulls are shown in table 2.

There was a significant difference between the averages for the different bulls. The data are consistent enough from year to year to show that 15 to 20 calves will indicate the transmitting ability of a bull.

Grades are not affected by factors such as age of calf, sex, year or age of dam, to the same extent as in weight. Our data indicate little need for correction of grades for any of these factors. Consequently, when parentage is known, it would not be difficult in practical operations to evaluate bulls for their ability to transmit grade.

We have used 9 scores in grading calves (beginning with A plus and going down to C minus). If 15 or more calves from a bull average one half grade above or below normal, it is indicative of a superior or an inferior bull as far as ability to sire grade is concerned.

No discussion of this type would be complete without some comment on the success in predicting the transmitting ability of bulls from their appearance. When feed supply is ample, the major factor controlling rate of growth is the inherent size of the animal. It follows that large animals will sire rapid-growing calves. In general, this has been true of observations made on the college herd, especially in the type-size experiment. However, you can't predict with any degree of accuracy, relative growth rates of calves from different bulls.

Grade is determined by the balance of a number of characteristics, and is, consequently, more difficult to predict than potential weight. But even with grade, one can't get away from the old truism that like tends to beget like. This tendency indicates the continued use of visual selection in livestock improvement. The exceptions, however, make valuable records as a further aid in selection.

In summary, records kept on the college ranch have shown that there is significant difference in the weight and grade of calves sired by different bulls.

A group of 15 or more calves provides an index of the transmitting ability of a bull that is accurate enough to indicate distinctly superior or inferior sires. Calf weights are affected by age, sex, year, and age of dam. Before the differences between bulls can be shown, records on each calf have to be corrected so that these factors are the same. This makes the use of weaning weights as an aid in selecting bulls impractical except in experimental herds.

Grades of calves do not need correction and should be useful as an aid in selecting bulls in practical operation.

Table 1.--Relative Weights° of Calves from Bull with 2 or More Records Since 1944.

Bull No.	Yearly Records				Average
1	95.6	96.7			96.2
2	98.3	96.0			97.2
3	99.7	99.9			99.8
4	97.3	98.5	90.3		95.4
5	102.8	104.0	102.0		102.9
6	103.4	100.2	101.6		101.7
7	98.8	99.1	104.7		100.5
8	104.4	101.3	93.5	94.4	98.4
9	102.7	101.1	102.0	100.4	101.6
10	103.5	102.9	99.2	102.2	102.0

°100 = Yearly average for herd.

Table 2.--Relative Grade of Calves from Bulls with 2 or More Records Since 1944.

Bull No.	Yearly Records				Average
1	98.7	100.6			99.7
2	95.5	100.3			97.9
3	101.2	98.4			99.8
4	100.2	101.2	98.7		100.0
5	98.4	98.7	98.8		98.6
6	91.8	97.7	100.6		96.7
7	96.5	98.4	99.6		98.2
8	105.0	101.7	102.4	105.3	103.8
9	101.2	103.1	102.4	107.2	103.6
10	103.1°	96.0	99.6	96.4	98.8

°Only seven calves represented.

CHART SHOWING THE PRODUCTION HISTORY OF BULLS ON DISPLAY AT RANCH DAY

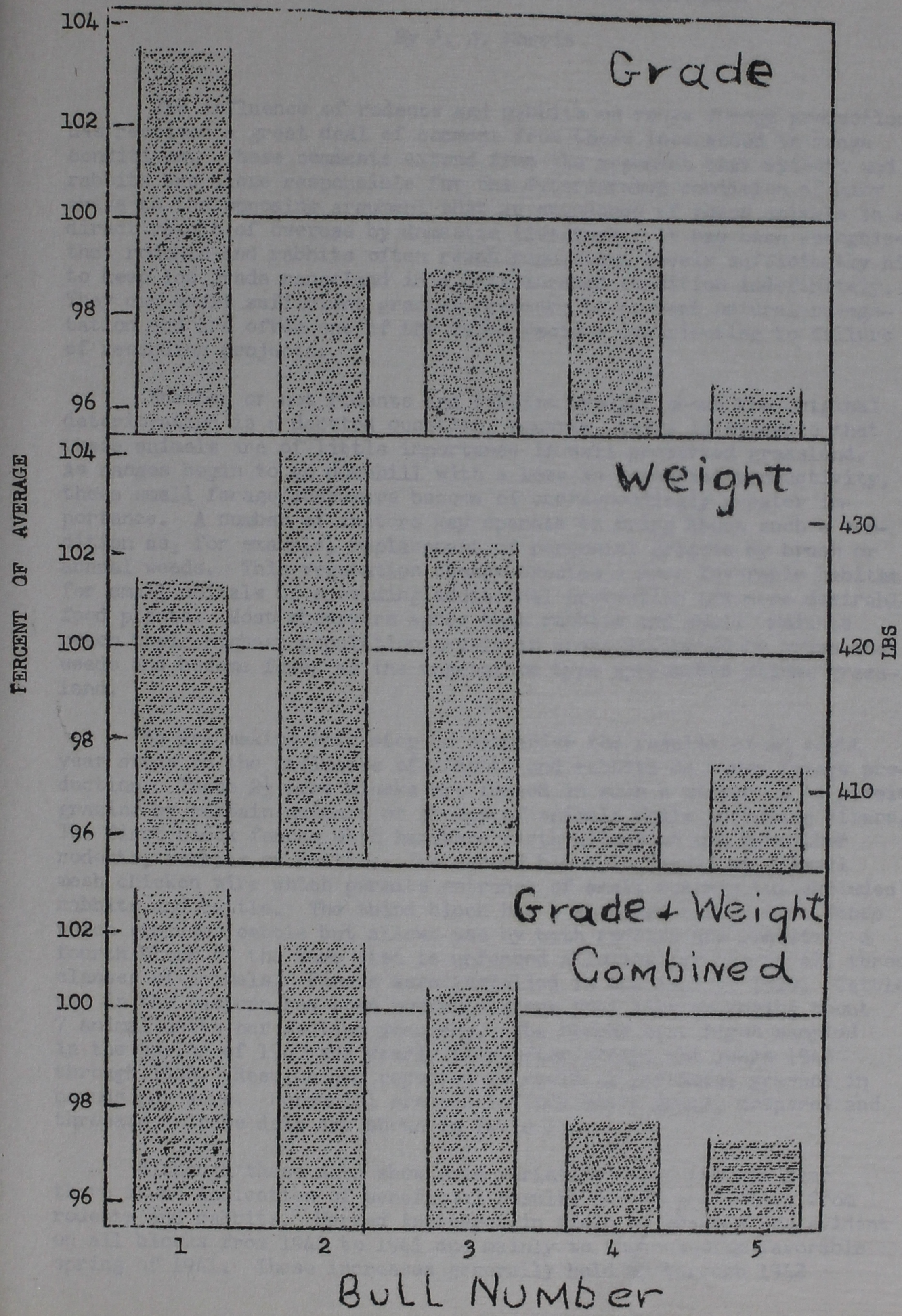


CHART SHOWING THE PRODUCTION MERITS OF BULLS
ON DISPLAY AT HANCH DAY

EFFECTS OF RODENTS AND RABBITS ON RANGELAND

By J. J. Norris

The influence of rodents and rabbits on range forage production has received a great deal of comment from those interested in range conditions. These comments extend from the argument that rodents and rabbits are alone responsible for the deteriorated condition of many areas to the opposing argument that an abundance of these animals is a direct result of overuse by domestic livestock. It has been recognized that rodents and rabbits often reach population levels sufficiently high to keep low grade rangeland in a deteriorated condition indefinitely. They can exert sufficient grazing pressure to prevent natural revegetation and are often one of the major factors contributing to failure of reseeding projects.

Whether or not rodents and rabbits brought about the original deterioration is a debated question, however, there is evidence that these animals are of little importance in well preserved grassland. As ranges begin to go downhill with a loss in potential productivity, these small forage consumers become of correspondingly greater importance. A number of factors may operate to bring about such a condition as, for example, replacement of perennial grasses by brush or annual weeds. This vegetation change creates a more favorable habitat for small animals by providing additional protection and more desirable food plants. Most observers agree that rabbits and small rodents reach their highest population levels in areas dominated by brush and weeds and become fewer as the vegetation type approaches climax grassland.

We are making this stop to summarize the results of an eight year study on the influence of rodents and rabbits on range forage production. These 2½ acre blocks are fenced in such a manner as to permit grazing by certain animals or groups of animals while excluding others. The first block fenced with hardware cloth allows no use by either rodents, rabbits or cattle. The second block is fenced with small mesh chicken wire which permits entrance of small rodents but excludes rabbits and cattle. The third block has a standard barbed wire fence which excludes cattle but allows use by both rodents and rabbits. A fourth block of the same size is unfenced allowing for use by all three classes of animals. Fences were installed in the fall of 1939. Cattle use in the pasture has been moderate since that time averaging about 7 animal units per section yearlong. The blocks were first sampled in the spring of 1940 and yearly thereafter except the years 1943 through 1946. Results are reported as yield of perennial grasses in pounds per acre. Perennial grasses include black grama, dropseed and threeawn. These data are shown in Table 1.

Although these data show some variations from year to year there is no indication of beneficial results due to protection from rodents and rabbits. Marked increases in yield of grasses are evident on all blocks from 1940 to 1941 due mainly to the unusually favorable spring of 1941. These increases generally held up through 1942

following the 20 inch annual rainfall of 1941. The plots were not sampled during 1943 through 1946 leaving a considerable break in the data. Samplings in 1947, however, showed a yield increase over 1942 on all plots. This was followed by a yield decrease in 1948 probably because of the preceding rather poor season. It should be pointed out that yield increases from year to year are, in part, due to accumulation of old growth rather than current production. Differences in yields between protected plots are so slight as to indicate no benefits from the protection. The total increase from 1940 to 1948 shows the plots receiving the three degrees of protection very nearly the same with the plot receiving both rodent and rabbit use somewhat higher than the other two. This bears out the statement that protection from rodents and rabbits is of no benefit in well preserved grassland. The plot grazed by rodents, rabbits and cattle is considerably lower than the three protected plots because of cattle use. This use is probably excessive due to the continuous fence within 1/2 mile of water which causes considerable trailing across the plot. It should be mentioned that rabbit populations have been at low levels during the course of the study. Rabbits appear to be increasing again and perhaps a few years of high populations will alter the story.

Results from a similar set of plots in a deteriorated mesquite-snakeweed type show a different picture. This series is located in a pasture which has received no cattle use during the study, so comparisons are made only between plots closed to rodents and rabbits, closed to rabbits but open to rodents, and open to rodents and rabbits. Results reported as yield in pounds per acre of perennial grasses including dropseed, threeawn, bristlegrass, black grama, and tobosa are presented in Table 2.

These figures show a continual increase in yield on the plot receiving both rodent and rabbit protection up to 1947. The plot receiving rabbit protection but open to rodents increased much more slowly because of rodent pressure and also a poorer initial stand, however, the trend was upward. The plot which was open to both rodents and rabbits showed a decrease during the first year and did not equal initial production in the second year. From 1942 to 1947 this plot showed an increase as did the others. Yields on all three plots decreased from 1947 to 1948 probably because of below average growing conditions. In this vegetation type the amount of increase in yield under protection from both rodents and rabbits and rabbits alone is significantly greater than that in the unprotected plot. Increases over the 8-year period are 4-1/2 times as great or 300 pounds per acre more under complete protection and 2-1/2 times as great or 75 pounds per acre more under protection from rabbits alone than on the unprotected plot. This clearly shows that rodents and rabbits can exert sufficient grazing pressure to hold deteriorated sites in a state of limited production indefinitely.

Benefits from rodent and rabbit protection in poor sites are rather great and appear to lead to the conclusion that control of these animals will be practical. However, since high populations normally occur in such deteriorated sites control is difficult and likely to cost more than the value of extra forage produced. We have found continuous poisoning necessary to keep rodents out of fenced plots and

Table 1. Yield of Grasses Under Four Degrees of Protection in Black Grama Grassland.

	1940	1941	1942	1947	1948	Increase 1940-1948
	Pounds per acre					
Plot A Closed to rodents, rabbits and cattle	204.8	707.3	769.6	965.7	754.4	549.6
Plot B Closed to rabbits & cattle, Open to rodents	119.9	626.3	570.9	852.0	646.9	527.0
Plot C Open to rodents & rabbits, closed to cattle	88.8	488.9	595.1	1203.6	678.6	589.8
Plot D Open to rodents, rabbits & cattle	70.9	397.1	437.7	533.9	293.7	222.7

Table 2. Yield of Grasses Under Three Degrees of Protection in Deteriorated Mesquite-Snakeweed Type.

	1940	1941	1942	1947	1948	Increase 1940-1948
	Pounds per acre					
Plot A Closed to rodents, and rabbits	3.4	82.3	98.7	425.3	370.3	367.0
Plot B Closed to rabbits, open to rodents	0.4	0.4	9.9	172.1	140.5	140.1
Plot C Open to rodents and rabbits	3.2	0.8	1.3	104.9	68.4	65.1

the continual repoisoning of larger areas soon runs into prohibitive cost figures. From these studies we conclude that rodent and rabbit control in good black grama grassland produces no benefits. We also feel that benefits of extra forage from controlling rodents and rabbits in deteriorated sites will not balance control costs.

In conclusion, I would like to point out that more effective and economical methods of rodent and rabbit control are necessary. More information is needed on rodent and rabbit numbers in various sites and on seasonal and annual populations cycles. Most of all it is essential to evaluate conditions carefully before entering into a control program in order to determine the economic feasibility of such control.